FORM THREE NOVEMBER / DECEMBER HOLIDAY ASSIGNMENT

CHAPTER TOPIC ONE

COMPUTER NETWORKING AND DATA COMMUNICATION

- Definition of terms
- Purpose and Limitations of networking
- Elements of Networking
- Types of Networks

Computer network

A computer network is a collection of two or more computers connected to each other electronically. Computers in a network may be linked through cables, electromagnetic waves or satellite. A computer network comprises of network software, transmission media, computers and network device. The primary role of computer networking is to share information and resources. Computers in a network can either be servers or workstations; workstations are the computers in a network that a user uses to interact with the network and utilize network services while servers are computers in a network that are not used directly by users but run continuously to provide services through workstations. Communication between computers in a network can be locally or internationally if they are connected to the internet. Devices that can connect to a computer network are called communication devices such as a hub, router, switch, firewall, terminal etc. examples of resources that can be shared in a computer network are; printers, files, application programs, routers, disk drives.

1. State three stand alone networks
2. With the aid of a diagram explain data communication.
3. Differentiate between the following terms;

i. Network node and network resource

ii. Dumb terminal and Intelligent terminal

iii. Workstation and client computer

iv. Local computer and remote computer

5. State two advantages and two disadvantages of peer-to-peer network
6. Explain three advantages of server based network compared to peer-to-peer network

ELEMENTS OF NETWORKING

These are entities that make networking and sharing of resources and information possible. They are; data communication medium, data signals, communication devices and network software.

1. Data communication medium

This is the pathway that carries data signals from the sender to the receiver. Data communication media transmit data signals from one device to another. A communication medium has a certain capacity for transmitting information, often measured by its data rate in bits per second (bps).

Bandwidth; The amount of data that a transmission medium can carry at any one time.

Categories of bandwidths

Narrowband; Used to transmit low data volumes at low speed.

Voice band; Used for moderate volumes data transfer at medium speed.

Broadband; used for large volumes of data at high speed.

Communication media can be inform of cables or wireless

Physical transmission media (cables)

Cables are used to transmit data signals by guiding them to move in only one direction from the source to destination. The signals are confined in a media; the common type of communication media. Other terms that have the same meaning are; wired, guided or bound transmission media. They include; twisted pair cables, coaxial cables and fiber optic cables.

Twisted pair cable

Twisted pair cables consists of pairs of insulated copper wires twisted together in a spiral pattern and put together in a protective sheath to form a cable. The two conductors are twisted together for the purposes of canceling out electromagnetic interference (EMI) from external sources and reduce crosstalk between neighboring pairs. Twisted pairs can be used to carry both analog and digital signal and their frequencies range from 5 MHz to 100 MHz.

Unshielded twisted pair (UTP)

UTP is often grouped into sets of 25 pairs according to a standard 25-pair color code originally developed by AT&T. A typical subset of these colors (white/blue, blue/white, white/orange,

orange/white) shows up in most UTP cables.

A computer network falls in to two categories; client-server network and peer-to-peer network. Server based network uses one or more powerful dedicated computer called server to facilitate central control of network resources while a peer-to-peer network has no central control of network resources and all computers provide same services and have equal privileges. Services from a server computer are accessed through a terminal or workstation. Servers are given names based on their purpose such as print server, web server, file server, database server etc. client computer is an equivalent of workstation or a network terminal.

Data communication

The process of transferring data from one point to another. Data communication involves the following elements;

Sender; the source of the message

Receiver (sinker); destination of the message

Transmission medium; the data carrier that can be physical or wireless.

In electronic data communication the sender and the receiver is a computer or communication device.

Data is propagated from one point to another by means of signals through data transmission media.

Data transmission

Data communication equipment is any device that can receive or send data signals in a network such as a modem, satellite, NIC (network interface cards)

Data terminal equipment is any device that is either the source or destination for digital data such as a printer, computer, router, servers etc

Data transmitted may be digital messages originating from a data source, such as a computer or a keyboard; it may also be an analog signal such as a phone call. Data transmission can either be serial or parallel.

Serial and parallel transmission

Serial communication data is transferred one bit at a time through a transmission medium while parallel transmission is the transfer of blocks of bits at the same time. In serial transmission data is send over a single communication path, while parallel transmission uses several transmission paths.

Modes of serial transmission

Synchronization is a principle applied in serial transmission where the receiving computer must recognize the beginning and end of bits send by the transmitting computer.

Asynchronous transmission; Data is transmitted one character at a time where each character is five to eight bits in length. Uses start and stop bits to signify the beginning bit ASCII character would actually be transmitted using 10 bits e.g.: A "0100 0001" would become "**1** 0100 0001 **0**". The extra one (or zero depending on parity bit) at the start and end of the transmission tells the receiver first that a character is coming and secondly that the character has ended. This allows the receiver to recognize when the second packet of information is being sent.

Synchronous transmission; data is send as one long bit stream or blocks of bits are send at a time

Data transmission modes

Simplex; data can only be transmitted in one direction only. Devices connected in this manner are either send only or receive only devices. E.g. computer to printer, computer to electronic board etc in this transmission it is not possible for the receiver to send the data back.

Half duplex; data can be transmitted in both directions but only in one direction at a time. e.g. walkie-talkies, cellular phones

Full duplex; data can be transmitted in both directions simultaneously. e.g. in computer network getting data from the server at the same time a computer is sending data to server

Advantages of computer networking

Resource sharing

A resource on the network is anything that serves the people or the network, can be inform of hardware or software. One network resource can sufficiently serve many network users saving the cost of buying and installing a resource to each computer on a network. Examples of resources are; printers, files, programs, disk drives, modems, scanners.

Remote communication

This is a communication between devices located at different geographical locations. A common example is two people at different places communicating using mobile phones. Remote communication can only happen if the two devices can see each other on the network. Remote communication increases operational flexibility and saves on transport challenges and expenses.

Distributed processing

Distributed processing is the use of a network designed in a way that one computer in a network can be offloaded tasks by other idle computers on the network. Distributed processing operating systems have the ability to detect idle computers and channel some tasks to them to utilize the idle CPU, speeding up processing. The tasks channeled to other computers a copy is stored in those computers and a copy send back to the source computer.

Cost effectiveness

This is brought about by sharing resources in a network saving the cost of buying resources for each computer on the network. Resource sharing by different workstations reduces the cost of running the network.

Reliability

Services offered by a network are reliable in that the failure of one workstation does not affect services offered by other workstations.

Central control of resources

In server based network data, hardware and software can be controlled from the server computer, which acts as a central system administrator.

Efficient communication

Computer network provides several different collaboration tools that can be used to communicate between network users. On line collaboration tools include; e-mails, chats, instant messaging, voice and video conference. Communication services offered by internet are fast, cheap and convenient.

Flexibility

A user can log in to a network anywhere as long as the computer is connected to the internet and

work from a remote site. This offers flexibility to the user as he can serve an organization or run his business from anywhere not necessarily reporting to work or attending meetings.

Disadvantages of computer networking

Data insecurity

Network users can access files in a network posing a threat if the records are private and confidential. Computer experts such as hackers pose a great threat to data and programs stored in computers as they can access the network electronically. Dishonest employees can also access the network and alter their records.

Rapid Spread of Computer Viruses

If any computer system in a network gets affected by computer virus, there is a possible threat of other systems being infected. These viruses can corrupt the databases, delete files, deny users some services and the worst scenario crash the server.

Expensive to set up

The initial set up cost of a computer network can be high depending on the number of computers to be connected and their separation distances. Costly devices like routers, switches, hubs, servers, cables etc increase the cost of setting up the network. In case of big networks, the File Server which is a powerful computer makes it expensive.

Network dependency

In server based networks dependency on the File Server may paralyze operations if the server breaks down.

Slow response time

Many requests send to the network server at the same time slows down the performance of the network. In server based networks sharing of the processing time and RAM slows the server. Printers in the network cause delay in production of work if many users are using them at the same time.

Moral and cultural effects

A network connected to the internet can pose some challenges to the network users by tempting them to visit some sites such as pornography, dating**,** social etc lead to moral degradation and

erosion of cultural values such as change of dress code.

Overreliance on the network

Overreliance on the network can cause some inconveniences incase one of the network devices fail such as switches, cables, server, router, printer. Network faults can cause lose of data.

Expert support required

Networks need constant monitoring to ensure that the performance is maintained and that all the components are working properly. Network support professional increase organizational expenses.

Revision exercise

1. State the difference between a proxy server and web server

TWISTED PAIR CABLES

Twisted pair cable is a physical channel made up of pairs of twisted copper wires interwoven as shown .The twisting of wires is meant to reduce noise by cancelling build –up of electromagnetic interference. The two common types of twisted cable used to transmit voice and data are Unshielded twisted pair(UTP) and shielded twisted pair(STP)

The difference between the two is that the UTP does not have protective shield provided in STP this makes UTP cable more susceptible to electromagnetic hence not suitable for outdoor and noisy environment. Currently ,twisted pair cables are classified into six categories according to data type and transmission rate.

Cable type	Data type	Transmission rate
Cat 1	**voice**	**< 1 Mbps**
Cat 2	**Data**	**1 Mbps**
Cat 3	**Data**	**16 Mbps**
Cat 4	**Data**	**20 Mbps**
Cat 5	**Data**	**100 Mbps**
Cat 6	**Data**	**200 Mbps**



UTP cable is also the most common cable used in computer networking. It has no shield to prevent electromagnetic interference.

Shielded twisted pair (STP)



It uses a foil wrap between and around the wire pairs. It supports higher transmission rate of a longer distance than UTP.

Twisted pair cabling is often used in data networks for short and medium length connections because of its relatively lower costs compared to optical fiber and coaxial cable.

Advantages of twisted pair cables

1. It is a thin, flexible cable that is easy to string between walls
2. Installation equipment is cheap, easy to use and readily available.
3. It is the least expensive media of transmission for short distances.

4. Can transmit both analog and digital data.

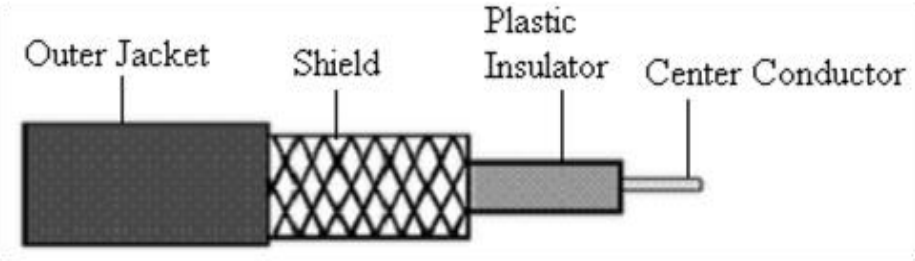
Disadvantages

1. High attenuation rates
2. Susceptible to electromagnetic interference.
3. Supports lower bandwidth as compared to other media.
4. Likely to break easily due to their thinness

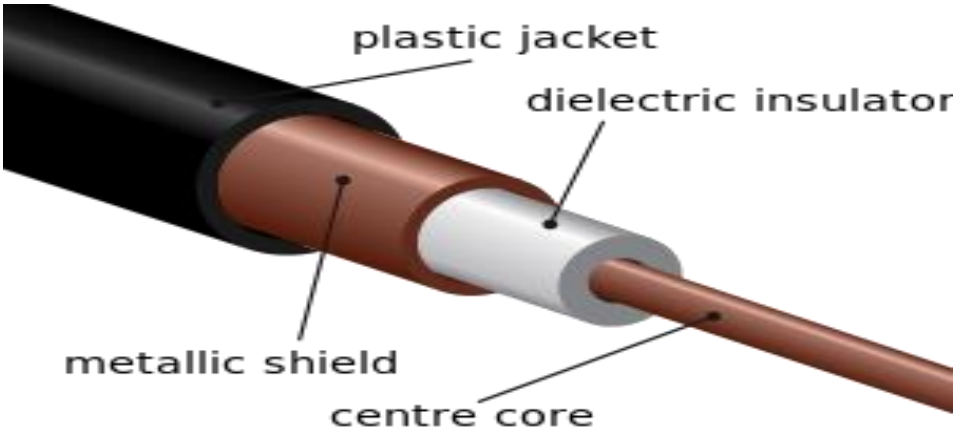
5. Offers poor security and it is easy to tap

Coaxial cable

I



t is a cable that has inner copper core surrounded by insulating layer and then a grounded shield of braided wire. Coaxial cable is the primary type of cabling used by cable television industry and also widely used in computer networks. All these layers are concentric around a common axis thus the term coaxial. This makes the cable resistant to EMI



Diameter of the core determines the rate of attenuation; the thinner the core the higher the rate. Coaxial cable is used as a transmission line for radio frequency signals, in applications such as connecting radio transmitters and receivers with their antennas, computer network connections, and distributing cable television signals. Data signals are transmitted using the central copper core, shield minimizes electromagnetic interference.

Categories

1. Thicket; a thick coaxial cable, has two dielectric insulators
2. Thinnet; thin coaxial cable has one dielectric insulator.

Advantages

1. Support higher bandwidth than twisted pair cables
2. Resistant to EMI than twisted pair
3. High data transmission rate
4. Cheap to install
5. Low attenuation rates compared to twisted pair cables

Disadvantages

1. Expensive to buy and install than twisted pair cables
2. Susceptible to damage from lighting strikes
3. Susceptible to noise

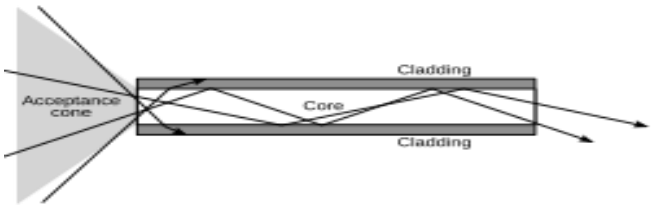
Fiber optic cables

Optical fiber is a thin, flexible, transparent hollowed glass twine that acts as a light guide. Permits transmission over longer distances and at higher bandwidths than other forms of communication media. Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference.

Optical fiber typically consists of a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. This causes the fiber to act as a waveguide. Fibers which support many propagation paths or transverse modes are called multi-mode fibers (MMF), while those which can only support a single
mode are called single-mode fibers (SMF).

Optical fiber can be used as a medium for telecommunication and networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables. This allows long distances to be spanned with few repeaters. Fiber is also immune to electrical interference; there is no cross-talk between signals in different cables and no pickup of environmental noise.

To confine the optical signal in the core, the refractive index of the core must be greater than that of the cladding. The cables can



be bundled together by protective tension resistance materials

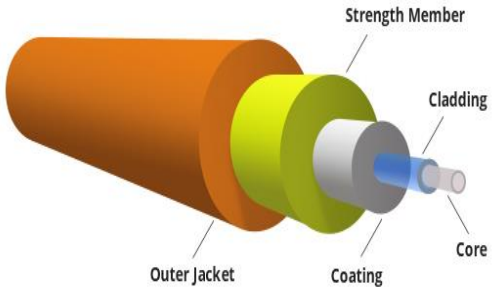
Single-mode fiber

The structure of a typical single-mode fiber.
1. Core: 8 µm diameter; the central part made of hollowed transparent glass strand
2. Cladding: 125 µm diameter; it redirects light back to the core (no loss)
3. Buffer: 250 µm diameter; surrounds cladding to strengthen the core.

4. Jacket: 400 µm diameter; the outer covering of the cable.



Fibre cables bundled together



Another important feature of cable is cable withstanding against the horizontally applied force. It is technically called max tensile strength defining how much force can applied to the cable during the installation period.

Advantages

1. Immune to EMI
2. Supports high bandwidth
3. Lower attenuation rates

1. Used for long distances
2. Has greater tensile strength than other cables.
3. Thinner and lighter than other cables
4. Difficult to tap
5. Resistant to corrosive materials

Disadvantages

1. cables are expensive
2. Installation is difficult
3. Fragile than other media
4. Broken cable is difficult to repair

Revision questions

1. State three situations where wired transmission media is is most applicable.
2. State two advantages of wired transmission media
3. With the aid of a well labeled diagram describe fibre optic cable stating its advantages and disadvantages
4. Explain why fibre optic cable is gaining wide spread use.
5. State any two advantages of distributed systems.

Wireless transmission media

This is transfer of data without any physical material. They are also called unguided or unbound transmission media. The lack of physical restrictions provides larger bandwidth as well as spans large geographical area. They operate at very high frequencies and the data signals are not confined to a path. They transmit communication signals using electromagnetic waves and mostly used when inconvenient, impractical, or impossible to install cables. They include;

Radio transmission

Radio waves are omni-directional i.e. they travel in all directions from the source. Because of this property the transmitter and the receiver need not be aligned. They can easily penetrate objects such as buildings and therefore used for both indoor and outdoor connections. At high frequencies radio waves tend to travel in straight lines and bounce off obstacles. At high frequencies the signals are projected in to the ionosphere that reflects them back this prevents them from being blocked by objects and cover large distances. Mostly used for Am and Fm radio, television, cordless telephones, cellular phones, wireless LAN. For frequencies that are blocked by obstacles the signals are transmitted by being broadcast to the atmosphere then transmitted back to the earth. Electromagnetic spectrum used for radio transmission consists of eight distinct ranges; very low frequencies, low frequency, middle frequency, high frequency, very high frequency, ultra high frequency, super high frequency and extremely high frequency.

Microwave

Microwaves are high frequency electromagnetic waves. They have a higher frequency than radio waves and therefore can handle larger amounts of data. It can be focused in to beams and transmitted between special receiving dishes. They can only travel in straight lines and are blocked by objects such as buildings; the transmitter and the receiver must be in line of sight, suitable for point to point transmission.

Some mobile phone networks, like GSM (Global System for Mobiles), use the low-microwave/high-UHF frequencies around 1.8 and 1.9 GHz in the Americas and elsewhere, respectively. Microwave radio is used in broadcasting and telecommunication transmissions because, due to their short wavelength, highly directional antennas are smaller and therefore more practical than they would be at longer wavelengths. There is also more bandwidth in the microwave spectrum than in the rest of the radio spectrum; the usable bandwidth below 300 MHz is less than 300 MHz while many GHz can be used above 300 MHz. Typically, microwaves are used in television news to transmit a signal from a remote location to a television station.

Wireless LAN protocols, such as Bluetooth, Metropolitan area networks: MAN protocols, such as WiMAX (Worldwide Interoperability for Microwave Access), Wide Area Mobile Broadband Wireless Access: MBWA protocols based on standards specifications use microwaves.

Advantages

1. High speed transmission
2. Can carry both digital and analog data
3. High bandwidth
4. Multiple channels available

Disadvantages

1. Signals are affected by atmospheric conductors like lightning
2. They suffer from attenuation due to atmospheric condition
3. They can be blocked by objects such as buildings
4. Towers are expensive to build

Satellite transmission

It is a microwave relay station. A satellite transmission system has three components; transmitter earth station, satellite and the receiver earth station. Signals are decoded using a decoder plugged directly to a TV set or a computer. The transmitter earth station picks signals and transmits them to the satellite; satellite receives the signals, cleans them and broadcasts them to receiving earth station at different frequencies. Signals from the satellite can be received by any person with an appropriate dish located anywhere in the world.

In the context of spaceflight, a **satellite** is an object which has been placed into orbit by human endeavor. Such objects are sometimes called **artificial satellites** to distinguish them from natural satellites such as the Moon.Satellites are used for a large number of purposes. Common types include military and civilian Earth observation satellites, communications satellites, navigation satellites, weather satellites, and research satellites. Space stations and human spacecraft in orbit are also satellites. Satellite orbits vary greatly, depending on the purpose of the satellite, and are classified in a number of ways. Well-known (overlapping) classes include low Earth orbit, polar orbit, and geostationary orbit. Satellites are usually semi-independent computer-controlled systems.

A: receiving dish

B: satellite

C: downlink

D:up link

Advantages of satellites

1. High band width
2. Covers wide geographical area

Disadvantages of satellites

1. High initial cost of setting up

2. Propagation delays
3. Noise and electromagnetic interference
4. Interference by weather conditions such as lightening
5. Signals can be received by any person with appropriate receiving dish.

Bluetooth transmission

Uses short range radio waves to transmit data at a rate of 1Mbps among Bluetooth enabled devices. Bluetooth enabled devices include; laptops, cellular phones, fax machines, printers etc. a network formed by Bluetooth connectivity is called piconet.

Infrared transmission

Communication through this medium is achieved by having infrared transceivers. Transceivers must be in line of sight. Mostly used in TV remote controls but can also be used to communicate between computers or cellular phones.

Wireless fidelity (Wi-Fi)

It is a local area wireless technology that uses high frequency radio waves to transmit and receive data over a few hundred feet to Wi-Fi enabled devices. Wi-fi enabled devices can connect to a network or internet using wireless internet or network access point. It does not need line of sight principle since it can penetrate objects such as buildings.

Advantages of wireless

1. Flexibility; Devices can be moved around without losing network or internet
2. Span large geographical area especially satellites, microwaves and radio waves
3. Can be used in remote area where there are no infrastructure like telephone cables, or in unreachable places such as beaches
4. Ideal for temporary network setups.

Disadvantages

1. High setup cost
2. Difficult to configure

3. Less reliable due to speed interference by factors such as buildings, atmosphere, weather etc.

Revision exercise

1. Using a diagram describe line of sight principal in microwave transmission
2. Explain five types of frequencies used in radio transmission
3. Describe how a cell phone is connected to a laptop if both are Bluetooth enabled to transfer files from the cell phone to the laptop.
4. State two advantages of Bluetooth connectivity over infrared connectivity
5. Describe the components of satellite transmission system
6. Explain two factors that have led to shift from wired connectivity to wireless connectivity in networking

2. Data signals

Data signal is an electronic pulse or frequency or light that represent data as it travels from one point to another.

The signal can either be analog or digital. Digital signals are signals represented by binary numbers, 1 or 0. Digital signals represent discrete data i.e. data with fixed set of values and the values change to each other with no time transition. Analog signals are continuous in both time and value and can take any real value. Analog signal is represented by a sine wave while digital signal is represented by a square wave.

3. Communication devices

Communication device is hardware that allows computers in a network communicate to each other. They include; Modems, hub, switch, repeaters, network cards, routers, brouters, bridge, gateway etc

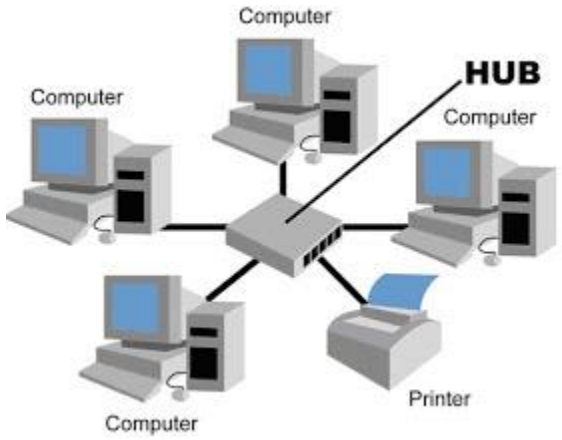
Modem

Traditional modems were used on dial up networks to convert digital data signal from the computer to analog data signal for transmission over telephone lines and convert analog signal

back to digital for storage and processing in the receiving computer. The process of converting digital signal to analog is called modulation while reverting back is demodulation. Broadband modem is a digital modem that connects a computer to the internet. They get their name by sending and receiving large amounts of data over a wide band of frequencies and they have replaced the older modems that relied on telephone lines. Some devices have inbuilt modems such as cell phones, tablets, ipads that can be used to connect them to internet. Common examples of external modems are; safaricom 3G modem, airtel modem, orange modem etc

Hub

Commonly used in local area networks with small number of computers. Its main function is to connect devices in a network to a central common point allowing communication between devices on the same network. It transmits signals by broadcasting them to all computers on a network; the rest of computers on the
network ignore the message only the computer whose address is on the message picks the message. Several hubs can be connected together to expand network



Switch

It is a special type of hub that filters and forwards packets of data directly to a port based on packet address. The main difference between a hub and a switch is that the switch does not broadcast signals instead it sends to a specific computer whose message is addressed to. A switch

has more ports that a hub.



Repeaters

It is a device that receives signals from one segment of a network cleans it to remove any distortion, boosts the signals and sends it to the next network segment. They are used to reduce attenuation problems and expand the network. A common example of repeaters is safaricom communication boosters.

Bridges

It is a device that connects local area networks or segments of the same LAN to form a larger network. LANs at different geographical locations that belong to the same organization can be connected together to become part of the whole network using a bridge. E.g. Banking institutions have LANs at different branches but all these LANs are connected together to head quarter through a bridge.

Routers

A network device that forwards data packets between computer networks. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISPs network. A router can connect a LAN to internet through ISP for the LAN to receive internet resources.



provider they are connected to. The Internet is the best example of many data networks from

different organizations all operating under a single address space.

Terminals attached to TCP/IP networks are addressed using IP addresses. There are different types of IP address, but the most common is IP Version 4. Each unique address consists of 4 integers between 0 and 255, Transmission control protocol (TCP) governs how data is transmitted from one point to another while internet protocol (IP) determines the addressing system on the internet i.e enables data to be sent and received by different computers on the network. Each computer on the network is recognized by its IP address, usually separated by dots when written down, e.g. 82.131.34.56.

Other protocols include;

1. Simple mail transfer protocol (SMTP)
2. File transfer protocol (FTP)
3. Hypertext transfer protocol (HTTP)
4. Internet message access protocol (IMAP)
5. Ethernet globalization protocol (E6)
6. Secure file transfer protocol (SFTP)

Types of computer networks

One way to categorize networks is using their area of coverage.

Computer networks are classified in to LAN, MAN and WAN.

Local area network (LAN)

A small network constrained to a small geographic area. An example of a LAN would be a computer network within a building or floor. It has high speed data transfer rate. Most LANs use physical cables to connect computers. Often LAN is a private network belonging to an organization or business. Wireless LANs use radio signals (Wi-Fi) to connect computers instead of cables.

A peer-to-peer or client-server method of networking may be used.

Metropolitan area network (MAN)

This is a medium sized network that covers an area larger than LAN and smaller than WAN such as a town, city. MANs connect several LANs together using high speed lines or wireless communication. E.g. municipal council's network.

Wide area network (WAN)

This is a network that spans large geographical area larger than metropolitan area such as a country, countries, continent or world. An example of this is a multinational business that uses a WAN to interconnect their offices in different countries. The largest and best example of a WAN is the Internet, which is a network composed of many smaller networks. The Internet is considered the largest network in the world. WANs use wireless technologies such as satellites, microwaves etc because of their large geographical area. Several LANs can be interconnected to cover several countries forming a WAN.

Revision questions

.a). state the role of each of the following data communication devices.

- Repeater
- Router

b) i) a company has three branches A,B and C where A is the headquarter. The local area network (LAN) at A is directly connected to the LAN at B and directly to the LAN at C. Explain two benefits of having the LAN at B also directly connected to the LAN at C.

ii). State three ways in which a company can protect its network from hackers.

2. a). What is meant by Data communication equipment?

b). List six examples of data communication equipment

c). A company in town wishes to link its offices together. The linking may be through wireless or fibre optic network media

i). state two benefits that the company would gain from the use of metropolitan area network (MAN)

ii). State three advantages of using wireless over fibre optic network media

iii). State three limitations of wireless communication

iv). State two transmission media used in wireless transmission

d). state two characteristics of an effective data communication system

3. state four functions which are specific to Network operating systems

4. i). The figure below shows how data is transmitted through a public telephone line.

Name A,B,C and D.

ii). State two advantages of using fibre optic cables over satellite in data communication.

Network topology

Network topology refers to the physical layout or the arrangement of computers and other components on the network. The basic standard topologies are; star, mesh, bus and ring topology.

Think of a topology as a network's virtual shape or structure. This shape does not necessarily correspond to the actual physical layout of the devices on the network. For example, the computers on a home LAN may be arranged in a circle in a family room, but it would be highly unlikely to find a ring topology there.

Choosing network topology

1. Reliability of the network
2. Expandability
3. Available space

1. Cost of setting up

2. Transmission speed

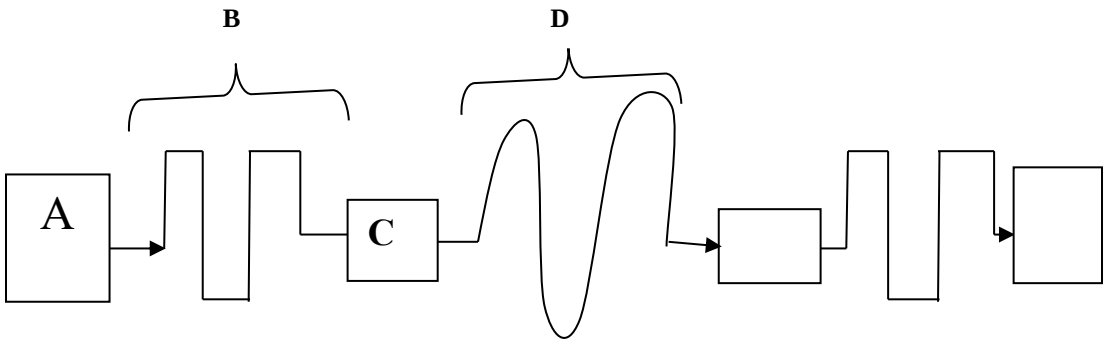
Bus Topology

All the devices in the network are connected to a single central cable called bus. A single cable, the backbone functions as a shared communication medium that devices attach or tap into with an interface connector. A terminator which is usually a resistor is added at the ends of the cable

to prevent bouncing back of signals. A device wanting to communicate with another device on the network sends a request to the cable and as soon as the cable becomes free it broadcasts the message on the line. As the message travels on the cable, each computer checks whether it is a dressed to it, the message is picked up by the addressee computer which then sends an acknowledgement to the source computer to free the cable.

However, bus networks work best with a limited number of devices. If more than a few dozen computers are added to a network bus, performance problems will likely result (signal jam). In addition, if the backbone cable fails, the entire network effectively becomes unusable.





Advantages

1. Easy to set up
2. Cheap because it uses short length cables
3. Easy to expand the network
4. Failure of one computer does not affect the functioning of the network.

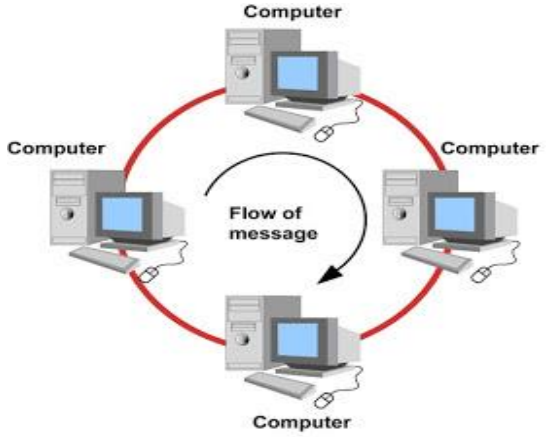
Disadvantages

1. If the cable fails the whole system breaks down
2. It limits the number of computers that can be connected on the network

3. Troubleshooting a cable fault
4. Its response time reduces with increase in number of computers
5. Security is very low because all computers share a common cable

Ring Topology

In a ring network, all devices are connected to one another in the shape of a closed circle. Every device has exactly two neighbors for communication purposes. All messages travel through a ring in the same direction ("clockwise" or "counterclockwise"). The message on the ring is only picked by the addressee computer otherwise it is passed to the next computer. A failure in any cable or device breaks the loop and can paralyze the entire network.



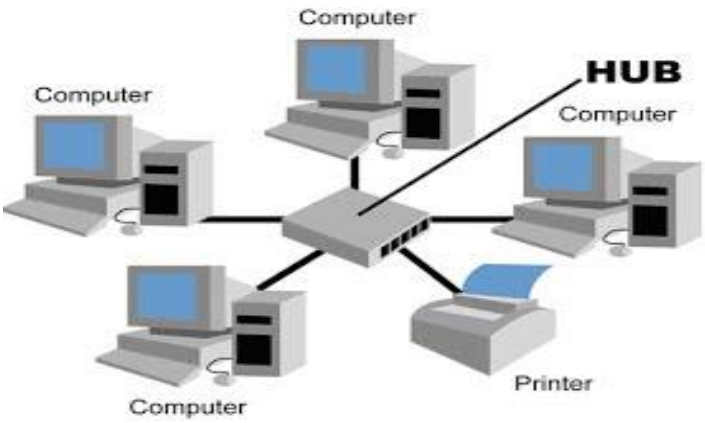
Advantages

1. Easy to install
2. If one of the computers breaks down alternate routing is possible
3. It uses short length cable hence cheap

Disadvantages

1. Failure of one computer can affect the whole network
2. Difficult to troubleshoot because the fault could be in the cable or one of the computers
3. Adding or removing computers disrupts the network

Star Topology



All devices on the network are connected in to a central hub or switch. When the hub receives data from a transmitting computer it broadcasts it to all computers on the network. Compared to the bus topology, a star network generally requires long cables, but a failure in any star network cable will only take down one computer's network access and not the entire LAN. If the hub fails, however, the entire network also fails.

Advantages

1. Easy to install
2. Addition of computers does not affect the speed of data transmission
3. If any of the local computers fail the rest are not affected
4. It allows centralization of key networking resources

1. Easy to expand

Disadvantages

1. If the central hub fails the entire network fails
2. Costly because it requires complete cable per computer

Tree Topology

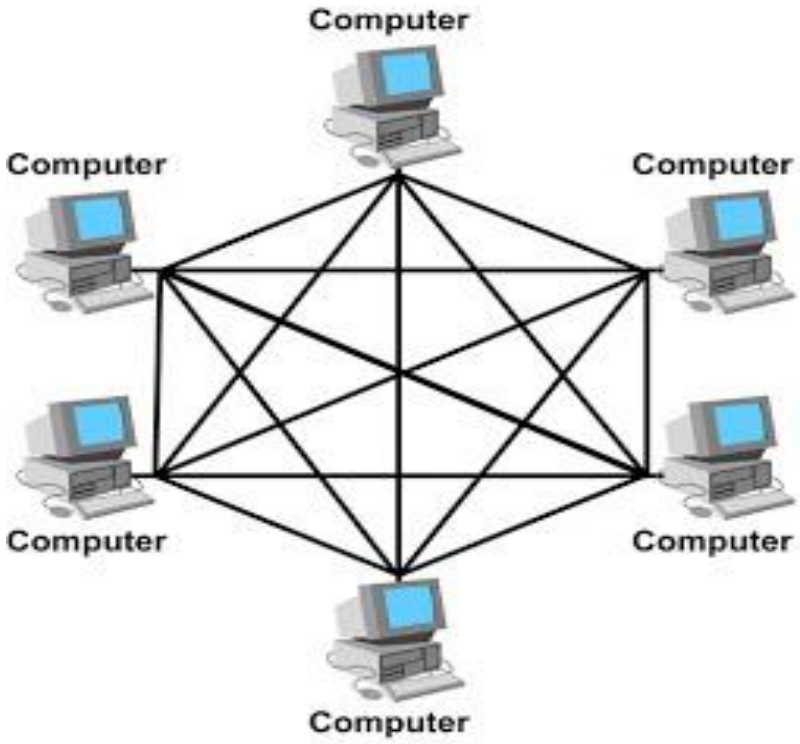
Tree topologies integrate multiple star topologies together onto a bus. All the devices are connected in form of a tree with the devices as leaves and links as branches. This bus/star hybrid approach supports future expandability of the network much better than a bus. It has a root node, intermediate nodes and ultimate nodes arranged in a hierarchical structure. It has disadvantages of a bus topology and advantages of star topology.



Mesh Topology

All devices are connected with many redundant interconnections between the nodes to allow straight communication paths. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination. Used in mission critical networks such as banking to ensure quick response regardless of numbers of computers in the network

A mesh network in which every device connects to every other is called a full mesh. As shown in the illustration below, partial mesh networks also exist in which some devices connect only



indirectly to others.

Advantages

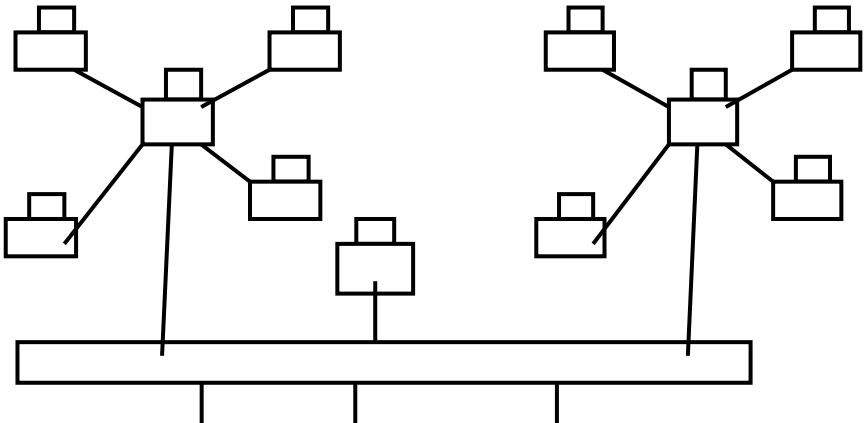
1. Easy to troubleshoot
2. Guaranteed communication channel capacity
3. Fault tolerance

Disadvantages

1. Expensive because of many cables required
2. Difficult to install

Hybrid topology

It is a topology that combines two or more standard topologies e.g. a star and bus topology



Revision exercise

1. State the function of each of the following:-

(a) Network protocol

(b) Hub

2. a) define network topology

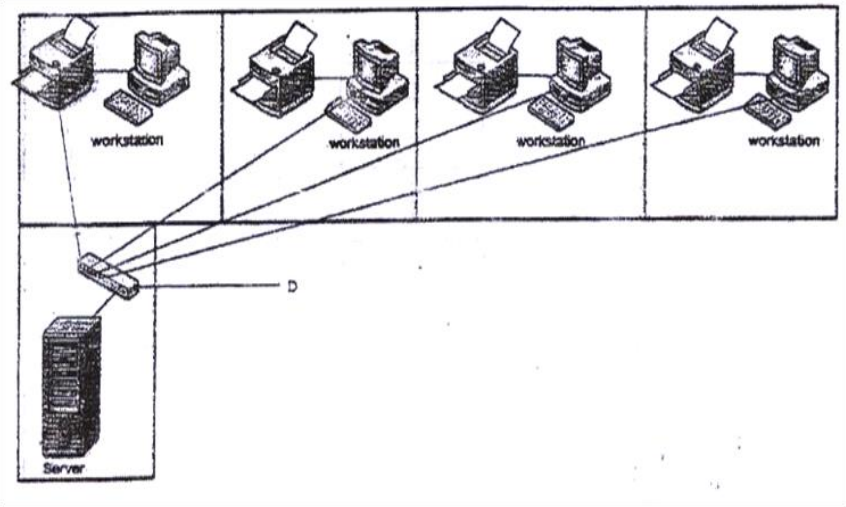
c). describe a bus topology

3. The diagram below shows a layout of a computer network used by a law farm. A workstation and a printer are located in every consulting room

(i) Name the network topology depicted in the diagram

(ii) Name the device labeled D

(iii) State four functions of the device labeled



. Distinguish between the following communications device

a) Bridge and NIC

b) Switch and Hub

c) Routers and Brouters

5.Explain the following terms as used in Networking: -

i) Point-to-Point connection

ii) Broadcast

iii) Packet switching

Iv) token ring

6. List three differences between Wide Area Network (WAN) and Local Area Network (LAN)

7. Briefly use diagrams to explain the following data transmission methods

(i) Simplex

(ii) Half duplex

(iii) Full duplex

8. (ii) **List two** disadvantages of microwaves in networking

(ii) State 3 types of hubs

(iii). state the difference between a hub and a switch

9.a) Distinguish between guided and unguided transmission media and give one example of each.

b) State and explain two networking problems faced in the last general election i.e 2013.

10. a) A computer user is unable to retrieve a file stored in
would need to contact the network administrator.

b). Figure 3 shows a network based on the bus topology.

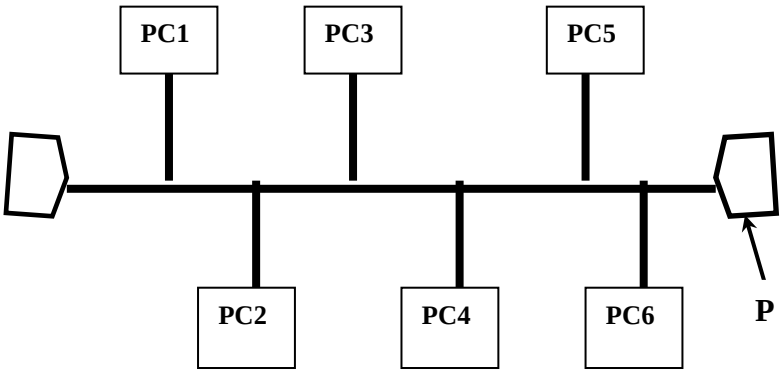


Figure 3

- Identify the component labeled P.
- State the function of the component labeled P.

11. The topology below is formed by combining two types of topologies.

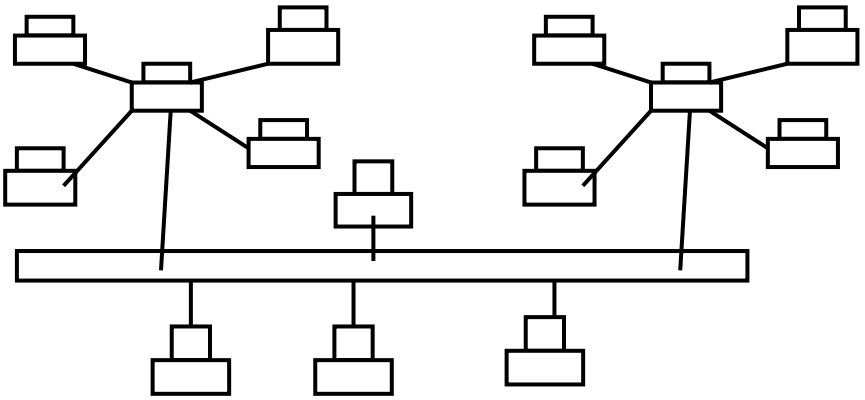


Figure 2

a). Give one name for the combined topology in **figure 2**.

b). Name the two topologies forming the combined topology in **figure 2**

CHAPTER TOPIC TWO

APPLICATION AREAS OF INFORMATION AND COMMUNICATION TECHNOLOGY

Content

Application Areas of Information and Communication Technology

1. Financial Systems

i. Accounting

1. Accounting software used to prepare accounting statements quickly
2. Online accounting solutions can be achieved through computer networking
3. Accounting software provide options for exporting reports to spreadsheet for further analysis
4. Accounting software are used to prepare neat and comprehensive reports
5. Details in the computer can be retrieved easily in the click of a button this makes payment of bills fast
6. Computers make general ledger flexible and easy to manage
7. Used in cloud computing
8. Electronic inventory control module makes inventory tracking for costing and taxing easy
9. Used to store volumes of financial records and secure records in the system

Banking

1. Keep client accounts details
2. Provide cash transaction services at the automatic teller machines (ATM)
3. Preparation of payrolls
4. Aid in processing of cheques
5. Communication e.g. e-mails
6. Electronic money transfer
7. Mobile banking
8. Managing financial transaction

iii. Payroll

Processing employees salary that involves additions of allowances and subtraction of taxes, loans to get the net salary.

2. Retail Systems

Electronic Point of sale

EPOS comprises of computer hardware, peripheral and software suited to a point of sale environment. It includes cash draws, printers, customer displays, keyboards, electronic funds transfer facilities, barcode scanners, mouse.

EPOS system is used in;

1. Recording sales
2. Updating stock levels
3. Provide accurate pricing information and customers change
4. Fast and efficient customer service
5. Keeping track of sales and taxes.
6. Mobile transactions e.g paying goods using M-pesa.

1. Electronic funds transfer where customers pay their goods using their ATM cards.

Stock control

The central server computer is used to control overstocking and under stocking by keeping a record of goods sold and goods remaining in stock. At the end of the day the database manager can see what is running out of stock and what is overstocked this regulates stock levels.

3. Reservations Systems

A computer reservation system is a computerized system used to store and retrieve information and conduct transactions related to air travel, hotels and car rentals. These system enable one to book hotels, rental cars or airline tickets online through a remote terminal. They use real time systems that provide immediate response to avoiding one facility from being booked more than once.

Computers in reservation system are used in;

1. Online booking
2. Keep reservation records

3. Online payments
4. Analyzing transactions
5. Communication between clients and offices

4. Communication systems

Fax and telex

A telex is a teletypewriter; what is typed in one machine is automatically relayed and typed by the other machine while a fax is
used to send a copy of text. Fax the short form for facsimile is a telephonic transmission of scanned printed materials and the two machines are connected by a telephone number. The main disadvantage of telex is that it can only sent text and not images.

Radio

Computers are used in radio communication to automate broadcast operations. Computers are used in the following ways;

1. A computer can run a facility in the absence of a human operator.
2. Automation software and voice tracks have replaced live DJs in broadcasting.
3. Computers use GPS satellite receivers to get exact time to broadcast satellite programs.
4. They are also used in transmission of a live broadcast to the head office and storing recorded adverts.
5. Computers are used in preparing the content to be broadcast and in back ground search.

Television

Computers are used in;

1. Preparing animations used in advertisements
2. Preparing video clips for TV broadcast
3. Preparing news to be read by news anchors
4. Used in background research
5. Storing news files

Video conference

This is the process of conducting a conference between two or more participants at different sites by using a computer network
and telecommunication facilities to transmit audio and video data. Each participant requires a

web cam, microphone, speakers and a computer system connected to the internet.

E-mail

Email is an electronic document send via the internet. Internet offers email facilities that are used to compose, send, forward, reply or attach other documents to an email. To send and receive emails one needs a computer connected to internet and email software (email client) or webmail.

Telecommuting

This is an arrangement in which employees do not commute to a central place of work. Employees work from a remote location that can be home, coffee shop, hotel room, cybercafé etc. Internet, faxes, phones, webcams, emails and instant messaging are some of the technological advances that make telecommuting possible.

Advantages

1. Saves transport cost
2. schedule flexibility i.e. employees work at their own assigned time
3. Reduces the hassle of transport and waking up early.
4. Increased saving especially on transport, official clothes, house helps
5. Saves company's money because no offices needed.
6. Reduces traffic jam as few people will be commuting

Work independence; some employees love working without
1. supervision

Disadvantages

1. There are few opportunities of braining storming with colleagues and if a problem occurs it may take long to be solved
2. Poor quality services especially by workers with bad attitude or incompetent because employees work without supervision
3. Time management challenges as it is difficult to separate work time from home responsibility
4. Inconveniences from family members and friends demanding your attention to chat, go shopping, outings etc.
5.

Internet

Internet provides fast, cheap and convenient means of communication such as e-mails, messaging, chatting, fax, phone call and conferencing

5. Education

Computer aided learning (CAL)

This is where the learner makes use of a specially designed software application to learn or practice some new skills. An example is a program run from a CD explaining some concepts in a subject.

E-learning

This is learning that takes place by using electronic media, educational technology and information communication technology

-learning includes numerous types of media that deliver text, audio, image animation, video streaming, video tapes, satellite TV, Digital content and computer based learning. E-learning can be in many forms that include;

i. Multimedia learning

ii. Computer based instruction

iii. Computer based training

iv. Computer assisted instruction

v. Internet based instruction

vi. Web based learning

vii. Online learning

viii. Virtual learning

Computer based simulation

Simulation is the imitation of operation of a real life process or system. In simulation a model is developed first that represents the system or object and simulation represent the operation of the system. Computer based simulation is a simulation that runs on a single computer or a network of computers to represent behavior of a system. Simulations make learning more interesting and lively, mostly used when teaching science and technical subjects such as biology, chemistry,

computer, and physics. An example of a simulation is a video clip showing the flow of blood in and out of the heart as used to circulatory system in biology. The diagram of the heart will be the model while simulation is the flow of blood in and out of the heart. Simulation is made possible by use of simulation software that can animate an object to represent real process.

6. Industrial systems

Industrial simulation

The model of a product to be manufactured is put to test to make it behave as if it was the real product for the manufacturers to examine the behavior of a system under certain circumstances. An example is testing the design model of an aircraft by changing the equations that govern how air craft fly, how they react to application of flight controls, the effects of other flight systems and how it reacts to external factors such as air density, turbulence, wind shear, cloud, precipitation etc.

Computer aided design (CAD) and computer aided manufacturing (CAM)

Computer aided manufacturing is the use of computer software to control machine tools and related machinery in the manufacturing of work pieces. In computer aided manufacturing a computer is used to assist in all operations of a manufacturing plant. Computer aided design is the use of engineering design software to make a 3D model of a product or component before the design is applied in the system.

Process control

In industrial process control a digital computer is used to direct the operations of a manufacturing process. A computer process control system can include;

1. Measurement of important process variables such as temperature, flow rate, pressure etc
2. Actuation of devices such as switches, valves, and furnaces that enable the process implement.
3. Generate reports to management indicating equipment status, production performance and product quality.

7. Scientific and Research Systems

Weather forecasting

Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location.

Computer based weather forecasting depends on accurate collection of data from weather stations, satellites and other sensitive devices all over the world. Computer is used to design models of hot, cold, humid and dry air interactions and how these interactions are affected by land and sea temperatures. A computer collects data on atmospheric phenomenon over a region and using the models the computer generates a forecast of how the air will change.

Medical research

Researchers in the medical field use computers to help design new medicines for instance a scientist can use a computer model of a drug molecule and study how it interacts with the model of a target site in the body. All information collected during research is stored in computers for future reference. Doctors create electronic presentations of certain diseases or treatment that are useful for juniors to understand. Scientists in medical research use
video conferencing, email facilities and news groups to share their ideas on a particular area of research.

Hospitals/health

1. Computers used to keep patients records
2. Computers are used to control critical surgeries
3. Clinical image processing such as body scans are done by a computer
4. Computers are used in analyzing clinical and biological tests to help in diagnosing a disease.
5. Computers are also used in life support systems
6. Doctors communicate to each other using communication services offered by internet
7. Used to monitor progress of patients
8. Booking doctors appointments

Military/ space exploration

Every aspect of space technology be it designing a spaceship, its control and navigation, or compiling and processing data is done by computers. Complex arithmetical computations needed to fly spacecrafts, monitor the work of astronauts in space, keep them alive, and analyze as well as interpret the collected data is done by computers.

1. Army use computers to track targets and vehicles
2. Tanks and armored vehicles have embedded computers that control and guided them on their locations and location of targets.
3. Military trained using computer simulators

Computers are used to collect and process data on personnel
1. and weather
2. Computers are used in communications
3. Computers used in biometric analysis

8. Transportation Systems

Air traffic control

1. Facilitate communication between controllers at the control towers and pilots
2. Air traffic controllers use computers to track exact locations of aircrafts in the air and instruct pilots to correct course of action.
3. Computers are used to guide pilots during landing and take off
4. Pilots use geographical position systems (GPS) to exactly follow the route despite darkness, bad weather or poor visibility.

Shipping control

The use of geographical position systems (GPS) in helping the captain to exactly follow the route despite darkness, bad weather or poor visibility.**Automobile traffic control**

Computers are used to control traffic light to allow them be coordinated in real time to deal with changing traffic patterns.

9. Entertainment Systems

Music and movies

Computers are used to record and edit music and movies in entertainment industry.

Computers connected to internet are used to download music and video, people use internet to watch movies and music.

Multimedia

Multimedia is the use of computers to present text, graphic, video, animation and sound in an integrated way. In multimedia industry computers are used in making slides for presentation, animations and simulations. Multimedia systems are used in; education and training, leisure and entertainment, virtual reality and simulations using video processing software, animation software, presentation software HTML and web scripting software. Multimedia systems may contain the following;

i. Large and high resolutions colored monitors

ii. Speakers, sound card, video card

iii. Microphones

iv. CD, DVD and Video tape players

v. Headphones and earphones

vi. Duo core processor

vii. High RAM capacity

viii. Music and video players applications

11. Virtual reality

This is a computer generated simulation of 3D image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment. such as helmet with a screen inside, gloves fitted with sensors. Computers are used to create a virtual environment and simulation of 3D
images.

Virtual reality is used in;

i. Military in training soldiers traumatic experiences

ii. Education to create and simulate models

iii. Medicine to combine scans to get their details

iv. Entertainment in creating computer games and animation

v. Engineering to design models

vi. File industry in animation

Components of virtual reality are; reality engine, head mounted display, body suit and gloves.

1. Reality engine comprises of a computer system, virtual reality software input and output

sensors

2. Gloves for controlling and interacting with the virtual world, gloves are connected in to the system through wires that provide sense of touch to the virtual world
3. Head mounted display has a screen where the virtual world is displayed for the user to see and interact with the virtual world. It also contains audio units.
4. Body suite used to change the body posture by applying some force depending on users psychological postures generated by interacting with the virtual environment.

12. Library Systems

1. Storing library materials records and library users details
2. Making electronic catalogues
3. Issuance and tracking of library materials

Generate reports on materials issued, returned, in stock and
1. out of stock, charge collections

13. Home use

1. Preparing personal budgets and documents
2. Entertainment especially playing computer games, music and watching movies
3. Online shopping
4. Surveillance by use of CCTV cameras
5. Information search and learning using internet resources
6. Communication using internet communication services such as e-mails
7. Social networking through internet sites
8. Teaching children how to operate computers

14. Offices

1. Preparing and printing office documents
2. Communication using internet communication services
3. Storing office documents

15. Marketing

1. Computers used to create graphics and animations used in business advertisements
2. Uploading and downloading adverts on the net
3. Making and storing adverts
4. Facilitate fast and convenient communication through, emails, chatting, conferencing, internet phone calls and instant messaging.

Revision exercise

1. Write in full hence, explain the term ICT.
2. State four areas where computers are used today.
3. State two ways in which a computer may be used in efficient running of a hospital.
4. Name the type of processing that would be required by a payroll system.
5. Identify two benefits of using computers in accounting systems.
6. a). Write down all the input and output devices of an ATM machine of Pesa-point in Kenya.
   b) List down three advantages of ATM cards.

7. a) State four components of an electronic Point-of-sale terminal.
b). Give two advantages of using electronic point-of sale terminals as opposed to manual entry at a supermarket checkout counter.

8. Define the following terms:
a) Biometric analysis
b). Telecommuting

9. Outline four devices required in order to conduct a video conference.

10. a) Define the term E-commerce
   b). List down two advantages of e- commerce as used in modern business environment

11. Describe how computing has been applied to each of the following areas:
i) Transportation systems.
ii). Reservation systems.

iii). Law enforcement

vi) Library management systems

12. Students of Neema secondary school formed an environment club with a goal of taking part in environmental conservation activities. Outline three ways in which they can use the internet to achieve this goal

13. Students of a school intended to elect their school captain by secrete ballot. State three ways in which computers can be used to improve the election process.

14. write each of the following acronyms in full as used in computing.

15. a worker is unable to travel to the office but may still be able to do the office work through telecommuting.

a). explain why the worker may use each of the following;

i). email

ii). Fax

iii). Digital camera

iv). Firewall

b). The worker needs to make regular backups of documents sent to the office. State three reasons for this

c). explain two benefits that the employer will get by allowing this worker to do the office work through telecommuting

16. Asha has a hardware shop and lately, she is finding the task of managing daily sales in the shop overwhelming.

a). state a retail system that she should acquire

b). state two input devices that are used in retail systems

c). apart from enhancing the speed of operation, state two other benefits that Asha will gain from using such a system.

17. A school has acquired a system that imitates human teachers, students can learn by getting answers from the system which they would normally get from the teacher. Give three advantages

of this system.

18. State three ways in which ICT can be used in shipping control

19. List two uses of computers in meteorology

20. Give three ways in which horticultural farmers can benefit from the use of Information and Communication Technology

CHAPTER THREE

IMPACT OF ICT ON SOCIETY

Content

- Effects of employment
- Automated production
- Issues of workers health
- Breakthroughs
- Cultural effects
- Environmental effects

Evolution of computer systems

Impact is a negative or positive effect. ICT has a direct or indirect impact on the society.

ICT stands for information communication technology

It is the use of computers and other telecommunication facilities to facilitate communication.

Introduction of ICT in the society has both positive and negative effects. These effects include;

i. Employment effects

ii. Health effects

iii. Cultural effects

iv. Environmental effects

v. Computer crimes

vi. Automated production

vii. Breakthroughs in technology

Even though people embrace change in technology introduction of computers in organization this introduction is slow due to resistance from employees.

Some managers and workers resist introduction of ICT to their places of work because;

1. Fear of change; people are creatures of habit, hence are afraid of change

2. Fear of losing their jobs: By installing the computer into an organization, employees fear that they might end up losing their jobs if they are not computer literate.

3. Fear of failure; people will be afraid that they might never get used to it.

4. Loss of control: The management fears that once a computer system is implemented, they

might lose control of the organization.

How organizations deal with the resistance

1. In-service courses
2. Attractive salary to ICT jobs
3. Managers take up the challenge by undertaking ICT courses
4. Introducing ICT in phases giving workers time to learn or adapt the changes

Effects on employment

Computer based information systems has affected job market. It has affected employment through;

i. Job creation
ii. Job displacement
iii. Job displacement

- **Job creation**; the use of computers in different areas has created job titles such as computer operator, software engineers, system management, network administration, web designing, system analysis etc people with ICT skills on the specific areas have taken up the jobs. ICT has created new fields that have absorbed IT experts in the market creating employment.

- **Job replacement**; some jobs have changed to incorporate the ICT skills; this is shift from traditional way of doing jobs to incorporate ICT. In job replacement employees without ICT skills are replaced by ICT skilled employees. E.g. accountant who used traditional ledger books is replaced with a IT skilled accountant who can use accounting programs.

- **Job displacement**; specialized computers called intelligent machines such as robots are replacing human beings in some fields of specialization. e.g. a large portion of manufacturing and assembly work in industries now done by robots. In this case some employees may be moved to other departments or lose jobs. Job displacement leads to downsizing and automated production. Downsizing; this is reducing the size of workforce in an organization. Production

can be fully or partially automated. In full automation intelligent machines take the jobs that were being done by human beings. E.g. a computer controlling temperature in a chemical plant. Job displacement reduces operation costs especially saving n salaries after some employees are send home.

Automated production

Automated production is the introduction of computers and computer controlled devices in a work environment to automate some processes. Full automation is where all the operations are carried out by automated machines.

Advantages of full automated production

1. Utilization of computers efficiency.
2. High production output.
3. Improves customer service delivery
4. Reduced accidents in a work environment where machines were operated by human beings.
5. Enables production of high quality goods in time
6. Enables efficient utilization of resources, e.g. raw materials, personnel and equipment; hence reducing operating expenses.

Disadvantages of automated production

1. Loss of jobs
2. High initial cost of setting up the systems
3. Over dependency on automated machines can cause inconveniences incase of system failure.

Health effects

The use of computers has resulted to the following health effects.

1. General fatigue and stress caused by prolonged sitting in front of the computer

Eyestrain due to poor screen positioning, light and radiation

1. from the screen
2. Back and neck pains
3. Repetitive strain injury; the stiffness of tendons and ligaments in fingers
4. Electromagnetic emissions; radiations emitted by computer components affect users health that may cause cancer, infertility, eye problems; experts in the computer industries are also prone

to these emission as they make the components e.g. mercury components, magnetic components, cathode rays from the monitors etc

Breakthroughs

The use of computers and computer controlled devices in different fields has brought some change especially in fields that require high degree of precision. ICT has raised the level of operations and service delivery in almost all fields where they are used, and their introduction has faced warm reception. Some of the areas where ICT has positively impacted are;

- Health care
- Education
- Communication
- Research
- Commerce
- Arts
- Entertainment
- Transport

Cultural effects

Erosion of morals and integrity e.g. watching pornographic movies, forging documents using computers etc

People are using computers to commit crimes e.g. fraud, piracy

Isolation due to prolonged use of computers leads to loneliness

The social network has affected youth especially in mode of dressing and communication

People are using internet to hook up with unknown social partners which is against societal norms.

Environmental effects

Computers consume a lot of electrical energy and therefore emit a lot of radiations and heat that affect the environment

Environmental pollution through damping of used or obsolete components e.g. printer toners and cartridges that affect soil

Evolution of computer systems

Computers continue to evolve and the old systems are becoming obsolete with time. Some of the characteristics of evolving computers are;

1. More powerful and reliable software and hardware
2. Internet connectivity
3. Reduced size of the hardware components
4. Cheap hardware and software
5. Can think like human beings

Artificial intelligence

A branch of computer science that is concerned with developing computer systems that thinks like human beings.

Ares of concern when developing the systems are;

1. Machine vision; systems that can move around, recognize owners, can perform daily home chores.
2. Speech synthesis and recognition; machines that can accept voice input and respond vocally
3. Psychomotor; movement of machines parts
4. Perception; development of machines that have the five common senses; touch, smell, sight, hearing and taste.
5. Machine learning; systems that can acquire knowledge
6. Natural language processing; systems that can understand and process natural human language.
7. Problem solvers; systems that can thing for human beings

Areas of application of AI

Artificial intelligence is applied in four main areas; expert system, natural language processing, artificial neural networks and robotics.

Expert systems

A computer system that emulates the decision making ability of a human expert. Expert systems do not solve general problems that do not require critical thinking. When fully developed these systems will be used in special fields such as medicine, mining, communication, flights, military, space explorations etc replacing human experts.

They are designed to solve complex problems by reasoning about knowledge like a human expert and not by following the procedure of the developer as it is the case of conventional programming.

Components of expert systems

An expert system has three main components; knowledge base, inference engine and interface.

Knowledge base

This is an expert systems database of knowledge about a particular subject. It has the necessary facts and assumptions for solving a problem. It is expressed in natural language rules. E.g. "if it is raining outside and John has no umbrella…., "it has facts about raining and umbrella and will rely on these facts to make a conclusion.

Inference engine

Inference engine is a computer program designed to reason logically basing its knowledge on rules. It takes the problem posed by the user and seeks to analyze it in order to arrive at a conclusion. E.g. "if it is raining outside and John has no umbrella then he will be wet"," if John is wet then he will be cold." The facts are drawn from the knowledge base and the inference engine makes a logical conclusion. It relates raining, no umbrella and becoming wet.

User interface

This is a display screen that the system communicates the conclusion to the user.

Natural language processing

An area concerned with developing programs that will make computers recognize and understand natural language. If successful computers can accept speech input, interpret spoken words or written words and respond vocally or by writing. Challenge in natural language processing is that the languages are ambiguous e.g. two soviet ships collide, one dies.

Artificial neural networks

N area concerned with developing software that mimics the connectivity and functioning of the human brain. Neural networks address problems that are often difficult for traditional computers to solve, such as speech and pattern recognition. They also provide some insight into the way the human brain works. One of the most significant strengths of neural networks is their ability to learn from a limited set of examples.

Artificial neural networks are modeled on the structure and functioning of biological neural networks. The most familiar biological neural network is the human brain. The human brain is composed of approximately 100 billion nerve cells called neurons that are massively interconnected. Typical neurons in the human brain are connected to on the order of 10,000 other neurons, with some types of neurons having more than 200,000 connections. The extensive number of neurons and their high degree of interconnectedness are part of the reason that the brains of living creatures are capable of making a vast number of calculations in a short amount of time.

Robotics

The field of computers science that deals with making of robots. A robot is a computer-controlled machine that is programmed to move, manipulates objects, and accomplish work while interacting with its environment. Robots are able to perform repetitive tasks more quickly, cheaply, and accurately than humans.

A robot has many arms with grippers that can move freely controlled by the computer. Grippers have sense of touch that makes them apply different forces when grasping objects. They also have sensors and cameras, grippers, or end effectors, are designed to mimic the function and structure of the human hand

Revision exercise

1.Identify four problems associated with the introduction of computers in a society.

2. Distinguish between “job replacement” and “job displacement” in reference to computerization

3.A recent breakthrough in the manufacturing industry is the development of a full manufacturing plant, that can produce vehicles using robots only.

a) Give three advantages of fully automated manufacturing.

b).State three other areas where automation is applicable

4. Discuss the applications of Artificial Intelligence in each of the following fields:

i. Expert systems

ii. Natural language processing

iii. Artificial neural networks

. Explain the impact of information technology on organization in each of the following areas

i. Competition

ii. Pace of growth

6. State three reasons why users may resist the introduction of information and communication Technology (ICT) to their place of work

CHAPTER FOUR

CAREER OPPORTUNITIES IN ICT

Content

Description of careers in the field of ICT

Identification of further Educational Opportunities

Careers in the ICT field.

Examples of some careers created by ICT and their functional roles.

Computer Operators

1. Monitor and manage the operations of computers hardware
2. Troubleshooting hardware devices
3. Giving data entry clerks technical assistance
4. Data back up
5. Works hand in hand with programmers, system analysts in developing and testing systems.
6. Securing data in a computer system
7. Working on data using application software.

Programmers

1. Develop, test and install application programs
2. Analyze and troubleshoot software errors
3. Upgrading software
4. Develop technical documentations to support applications maintenance
5. Train and guide users on technical aspects of application programs
6. Maintain application software
7. Install and maintain operating systems

1. Advise users regarding software design and techniques.
2. Consult with managerial, engineers and technical personnel to clarify program intent, identify

problems and suggest changes

Software Engineers

1. Design, develop and modify software systems
2. Coordinate software system installation and monitor functioning of hardware
3. Consult with customers about software system design and maintenance
4. Analyze users needs and software requirements to determine feasibility of design within time and cost constraints
5. Modify existing software to correct errors or improve its performance
6. Work with system analysts, programmers to design computer systems.

Database Administrators

1. Determines type of data to be stored in the database
2. Defining data security and integrity checks in a database
3. Defining data backup and recovery procedures
4. Monitoring performance of the database
5. Troubleshooting and maintaining database
6. Installing and testing new versions of DBMS
7. Writing database documentation
8. Developing database systems in collaboration with other IT professionals

System Administrators

1. Maintain a multi-user computer system
2. Monitor system performance and provide security measures, troubleshooting and maintain ace required.
3. Assist system users in resolving system technical issues
4. Design and implement systems
5. Identify areas that need upgrading in a system
6. Adding and configuring new workstations
7. Setting up user accounts
8. Monitor system components to ensure they work properly

Computer Technicians

1. Installing hardware and software
2. Provide technical support to end users
3. Advising organization on need of new hardware and software
4. Troubleshooting software and hardware problems
5. Maintain and manage a system and the related equipment
6. Interconnect workstations

Computer Engineers

1. Design, develop, implement and test computer hardware
2. Design, develop, implement and test computer software
3. They design networks that connect computer systems
4. Analyze computer hardware and software problems and come up with solutions
5. Updating hardware to work with new software

Computer scientist

1. They work on complex fields to develop new technologies, systems and computer based solutions.
2. Development of models for estimating the properties of computer based systems with an objective of discovering new designs that admit for improved performance.

Information Systems Managers

1. Keeping up to date with new technologies
2. Mentoring and training new ICT support staff
3. Offering users appropriate support advice
4. Securing data from internal and external threat
5. Ensuring software licensing laws are adhered to
6. Researching and installing new systems
7. Planning, developing and implementing ICT budget.
8. Evaluating user needs and making sure that these needs are met

Computer Trainers

1. Train and instruct students, learners and end users in computer operations
2. Design and develop computer instructional materials useful for learners and end users
3. Design, implement and administer training schedules
4. Evaluate and assess students progress

Implement new technologies and methodologies in training
1. issues
2. Developing new course materials
3. Prepare learners for examinations

Web Administrators

1. Test new software for use in web operations
2. Develop or document style guidelines for website content
3. Track, compile and analyze data usage in a website
4. Develop or implement procedures for website modifications
5. Maintaining websites
6. Design and develop websites

Systems Analysts

1. Examining current system
2. Collect information about current system
3. Provide specifications for new or improved systems
4. Liaise with other IT experts to develop a system
5. Implement the new systems
6. Train users and staff to work with computer systems
7. Recommend new software or hardware for a system

Network administrator

1. Troubleshooting the network

2. Installing new file servers and work stations
3. Installing a computer network
4. Advising managers on matters about networking

Further education in ICT

After completing secondary education one can enroll for IT courses in tertiary learning institutions. IT skills can be acquired in universities, polytechnic, middle level colleges and research institutes

Before enrolling for an ICT courses in any of the learning institutions one should consider;

1. Highest level of training e.g. degree, diploma, certificate
2. Cost of the course
3. Quality of education in that institution
4. Institution accreditation
5. Employment opportunities after completing the course

Universities

This is the highest institution of highest formal learning. They have minimum entry requirement that vary depending on the course. They are set up to offer two types of programs; undergraduate and post graduate. Their primary function was to offer degree courses but are also allowed to offer certificate and diploma courses. They are grouped as either private or public. They offer courses that are more theoretical in nature and provide good knowledge base.

Public universities

They are established and run by the state with admission controlled by a state appointed body.

Examples

1. Jomo Kenyatta University of Agriculture and Technology
2. Kenyatta University

1. University of Nairobi
2. Egerton University
3. Moi University

4. Murang'a University college
5. South Eastern University College

Private universities

Established and run by private bodies such as NGOs, churches, individuals etc.

To control establishment and quality of service offered by private universities they are registered by commission of higher education. Accreditation by the commission of higher education will lead to award of a university charter by the state for public acceptance.

Examples

1. Strathmore University
2. Kenya Methodist University
3. Catholic University of East Africa
4. Daystar University
5. Riara University
6. United States international university
7. Mount Kenya University

Examples of ICT related degree courses offered in universities are;

1. Computer science
2. Information technology
3. Business information technology
4. Computer studies

1. Information systems

Polytechnics

They are state owned and provide professional training on technical fields such as mechanics, carpentry, IT etc. Initially used to offer courses up to higher national diploma but nowadays some have been accredited to offer degree courses. They have minimum entry requirements. Most of the national polytechnics have been upgraded to universities to ease the burden of massive qualification by secondary school students who qualify for degree courses. They give more emphasis on practical and field work than theory.

Middle level colleges

They offer courses that are job oriented. They are established by either a private body or state. Examination can be internal or offered by independent external bodies such as KNEC, KASNEB, IMIS, city & guilds etc. They offer courses ranging from certificates to higher national diploma.

Research institutes

They are established by an organization to offer research services on specific areas. They offer research services to benefit the student and organization. Most institutions of higher learning have established research departments that have taken the work of research institutes. A student can join a research institute to get more knowledge and experience on IT related course such as artificial intelligence.

Revision exercise

1. Give a brief description of the following careers available in the computing field.

i. Software engineers

ii. Data processing managers

2. Differentiate between software engineer and a computer engineer

3(a) Sate three public universities where one can further her computer studies

(b) Identify at least three related courses offered at

(i) College level

(ii) University level

4(a) Name three responsibilities that are carried out by a:

(i) Web administrator

(ii) Computer trainer

5.Explain two factors one would consider before enrolling for an ICT course in a college

6.List two career opportunities directly associated with computer networking.

7.A firm operates an order system that coordinates orders, raw materials and inventory across its three factories. Currently the orders are processed manually at each factory and communicated to the others over the phone. The management intends to computerize their operations. State the first two computer professionals who will be required and their roles.

8. Arrange the following job titles in the order of their seniority.

Database administrator, ICT manager, system analyst